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The exploitation of the Greenland halibut stock complex of ICNAF Subarea 2 and Divisions 3KL

by

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Introduction

In the convention area, the only significant fishery for Greenland halibut occurs in Statistical Area "0", Subareas 1 and 2, and Divisions 3K and 3L with very small catches taken in Fortune Bay, St. Pierre Bank (3Ps) and the Gulf of St. Lawrence (4R). For most of the past 25 years the fishery for Greenland halibut in Subarea 3 was confined to the inshore bays of Newfoundland, however in 1963 the offshore fleet began to catch substantial quantities as by-catches of other fisheries. In the mid-1960's, the inshore fishery took large quantities from this stock mainly in Trinity Bay (Fig. 1). The inshore fishery then gradually declined from 1967 to 1974 and the major portion of the catch for these years was taken by the offshore otter trawlers. Since 1974 the inshore landings have been increasing and in 1977 the inshore fishery again became the major component of this particular part of the Greenland halibut fishery. The Newfoundland inshore fishery over the last few years changed from the use of baited longlines to the use of monofilament gillnets (165-203 mm) and with the introduction of larger boats, the local fishery is now more mobile and can range farther offshore. Although the general consensus amongst scientists involved with this species is that the whole complex for this species from the northern Grand Bank to West Greenland is a single interbreeding stock (Zilanov et al., 1976; Chumakov, 1975; and Bowering, 1977), for assessment purposes the area is split into 0 + 1 and 2 + 3KL. This document deals only with the 2 + 3KL stock.

Materials and Methods

The two main fishing operations on this stock are the Newfoundland gillnet fishery and the offshore otter trawl fishery with the major offshore effort coming from USSR and Poland. Sampling from the inshore gillnet fishery has been in effect since 1970 (Bowering, 1977) however until 1977 the sampling was limited to 3K. In 1977 sampling included all areas where inshore gillnets were in operation. Length and age compositions were compared for the three different areas sampled (Fig. 2 and 3) to show any differences from area to area.

From a previous assessment (Bowering, 1977) it was found that because of growth and mortality differences it was necessary to treat the sexes separately, therefore much data that had been collected (sexes combined) in previous years could not be used. In 1976 however, commercial sexed frequencies were available from the USSR (2G), Canada (2J), and Canada and Poland (3K). These were compared to indicate differences in the offshore catch composition between areas (Fig. 4). The first year of substantial sampling was in 1977 when sampling of the offshore fishery in all four quarters of the year (Fig. 5 and 6) occurred; however, since the Canadian effort was mostly in 3K there was little or no data from the other divisions.

Length frequencies were plotted for 1975-77 research data for Divisions 2J and 3K (Fig. 7). These data were collected by the Canadian research ships A. T. Cameron and Gadus Atlantica and the Federal Republic of Germany's research ships Anton Dohrn and Walther Herwig.

Length distribution by 100 metre depth categories for male and female Greenland halibut were plotted (Fig. 8 and 9) from Canadian research data. These data were collected by the Canadian research ship Gadus Atlantica during a random-stratified groundfish cruise in Division 2J during the fall of 1977.

Since the gillnet fishery is more selective than otter trawl, it was considered that the otter trawl fishery was probably more representative of the population. Estimates of total mortality (Z) were therefore computed from catch curves for males and females separately suing 1976 and 1977 commercial otter trawl data (Fig. 10). A natural mortality value of M = 0.20 was used in the calculations since an actual value was unable to be calculated. The Beverton and Holt yield-per-recruit model was applied to males and females separately (Fig. 11) and since there was no significant change in the parameters from the previous assessment (Bowering, 1977), the same curves were used here.

Results

Bowering (1977) indicated that the length composition of Greenland halibut taken by gillnet has changed over the past eight years in Division 3K with much smaller fish now being taken. In comparing the length and age composition of the gillnet fishery in Divisions 2J, 3K and 3L (Fig. 2 and 3) it can be seen that the difference between Divisions 3K and 3L is negligible with the main portion of the catch made up of 7-year-old fish with substantial numbers of older fish also making up the catch.

The 1976 commercial length composition from the otter trawl fishery (Fig. 4) indicates that the larger, older fish are caught in the most northerly areas. In Division 2G the main proportion of females (70-100 cm) are only incidental in catches from Divisions 2J and 3K. The small fish present in Divisions 2J and 3K frequencies are probably taken in small amounts on all commercial vessels and discarded. However, the numbers are probably not significant. In 1977, commercial otter trawl data were available from Division 3K for the four quarters of the year (Fig. 5 and 6). The size and age composition for all quarters except the third indicated that for all practical purposes there was no difference in catch composition. The catches were made up of mainly 40-60 cm fish from 5-10 years old. Although the sampling was insufficient for the third quarter, there were larger and older fish present that were not recorded in the other quarters.

Research surveys in Divisions 2J and 3K over the past three years indicate the presence of several strong year-classes (Fig. 7) of which some have now entered the selection range of commercial gear. It appears that these may be backed up by other good year-classes also but do not appear to be quite as strong. Unfortunately, all the ages for these samples are not as yet available.

The size-depth distributions for male and female Greenland halibut (Fig. 8 and 9) show a definite trend for smaller fish to inhabit shoaler water and larger animals to inhabit deeper water. The largest fish are found beyond 400 metres which would seem to be the lower limit of the best commercial size range. Beyond 400 metres there would appear to be little difference in the average size as it goes deeper.

The yield curves were almost flat-topped with F_{max} occurring at 1.28 for males and 0.35 for females for M = 0.20 (Fig. 11). Estimated levels of $F_{0.1}$ (Gulland and Boerema, 1972) for males was 0.58 and 0.18 for females. Estimates of total mortality from otter trawl data 1976-77 (Fig. 10) gave estimates of 1.3. for males and 0.55 for females. Both values are well beyond $F_{0.1}$ and very close to F_{max} for the males and just beyond F_{max} for females.

Discussion

The landings of Greenland halibut have increased rapidly over the past 15 years and for the past 10 years has been one of the major commercial groundfish species in the Northwest Atlantic. It has now become the main species next to cod for the inshore fishermen of Newfoundland with inshore landings in 1977 amounting to about 15,000 tons (Fig. 1). Many problems are associated with obtaining accurate estimates of the size of this stock because of its widespread distribution and limited knowledge of its migration patterns. The only information on migration patterns was unpublished results of two tagging programs by the St. John's Biological Station which indicated a northern movement of tagged fish presumably into deep water to spawn. The size and age distributions of the commercial otter trawl and gillnet catches presented here indicated that the larger,more mature fish were found to the north and in deeper water (Fig. 8 and 9), however the main portion of the catches were made up of immature fish which inhabit the continental shelf (Bowering, 1977). The catches in 1977 were extremely good as all allocations were taken with the exception of the USSR which only took 75% of its quota. This increase

in landings was probably the result of the presence of several strong year-classes which showed up in research surveys in 1975-77 (Fig. 7). In comparing these frequencies in 1977 research data (Fig. 7) and the commercial frequencies for 1977 (Fig. 2 and 5), it is obvious that these strong year-classes have now become the bulk of the commercial fishery. It is doubtful whether these high catch levels can be maintained when these year-classes have passed through the accessible fishery since the recruiting year-classes (while they appear good (Fig. 7)) do not appear nearly as strong as those presently being fished.

The present levels of fishing mortality for male and female Greenland halibut are high and in the vicinity of F_{max} (Fig. 11). These values are no doubt maximal since they do not reflect the catches of the larger, older fish taken in Division 2G (Fig. 4). These would tend to reduce slightly the slope of the present catch curves. However, the numbers of these fish actually caught are small in relation to the number of younger, immature fish and would probably not greatly affect these values. While these F values may not truly reflect the sustainable level of the total population (since there are presumably large, older fish not fished and probably not accessible by normal operations), they are indicative of the actual directed fishery on the continental shelf. Until the larger, older fish become a substantial portion of the total landings, the fishing mortality levels will tend to remain high on the heavily fished immature section of the population.

References

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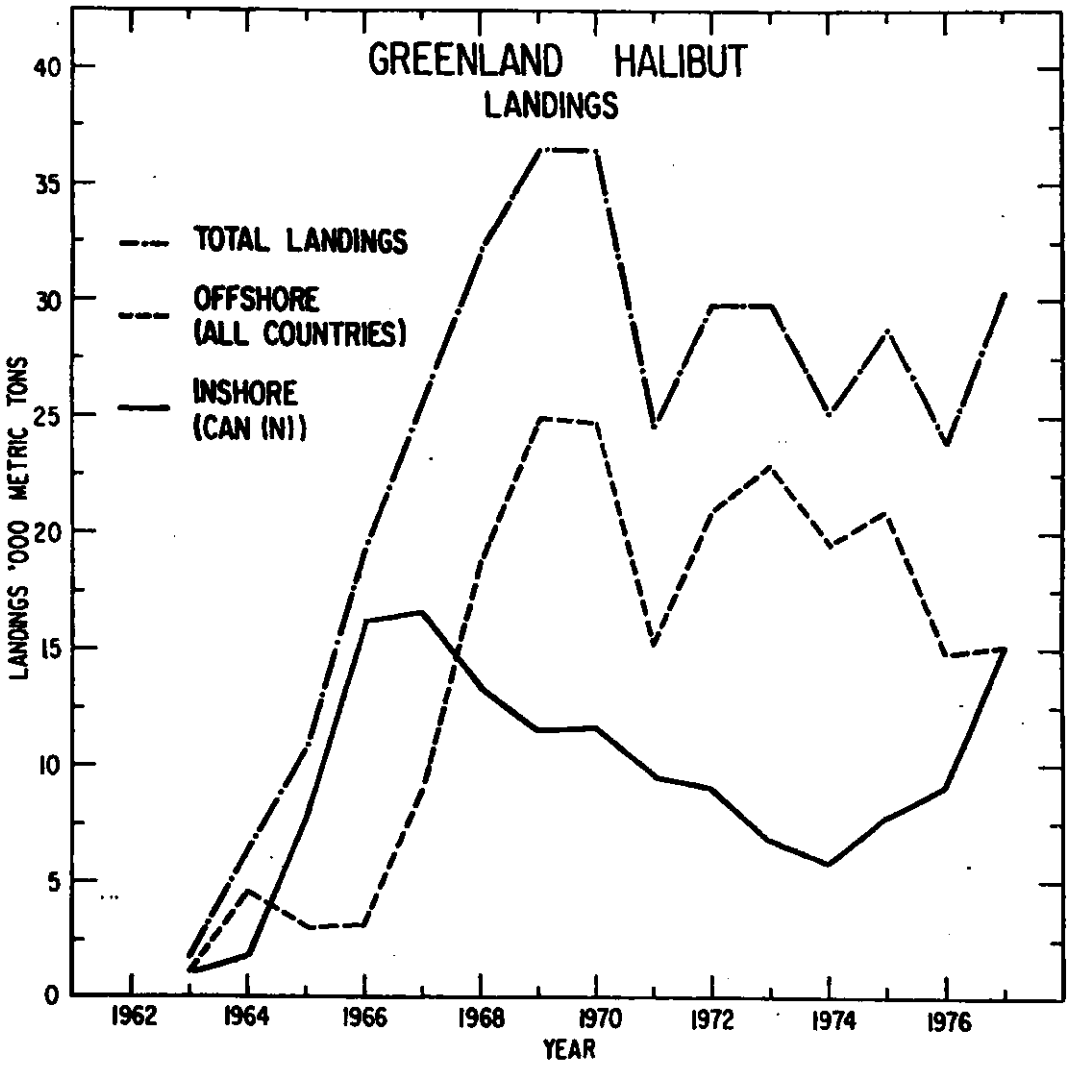

Fig. 1. Nominal catches of Greenland halibut from ICNAF Subarea 2 and Divisions 3KL for 1963-77.

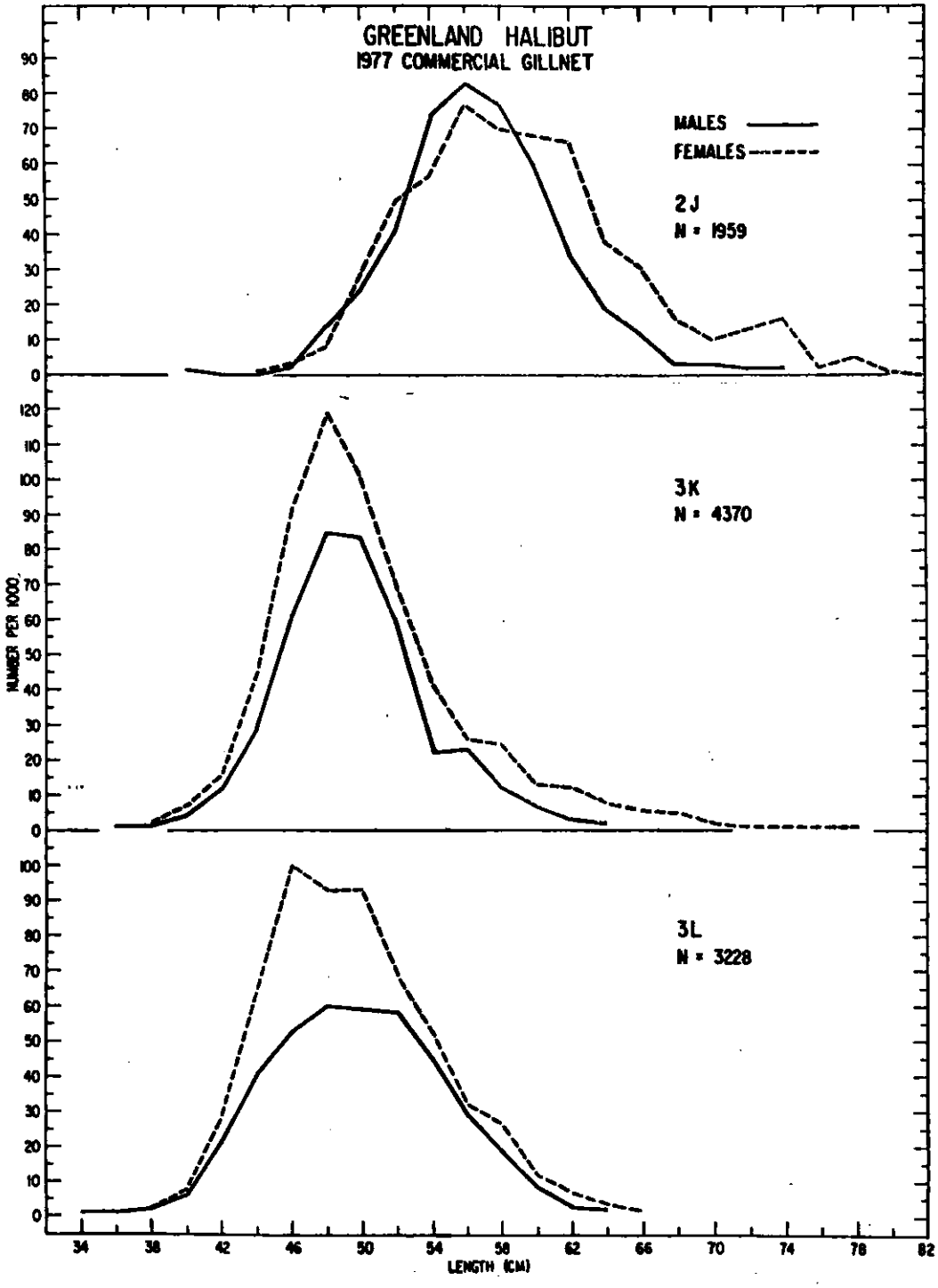

Fig. 2. Length composition of male and female Greenland halibut gillnet catches from ICNAF Divisions 2J, 3K and 3L for 1977.

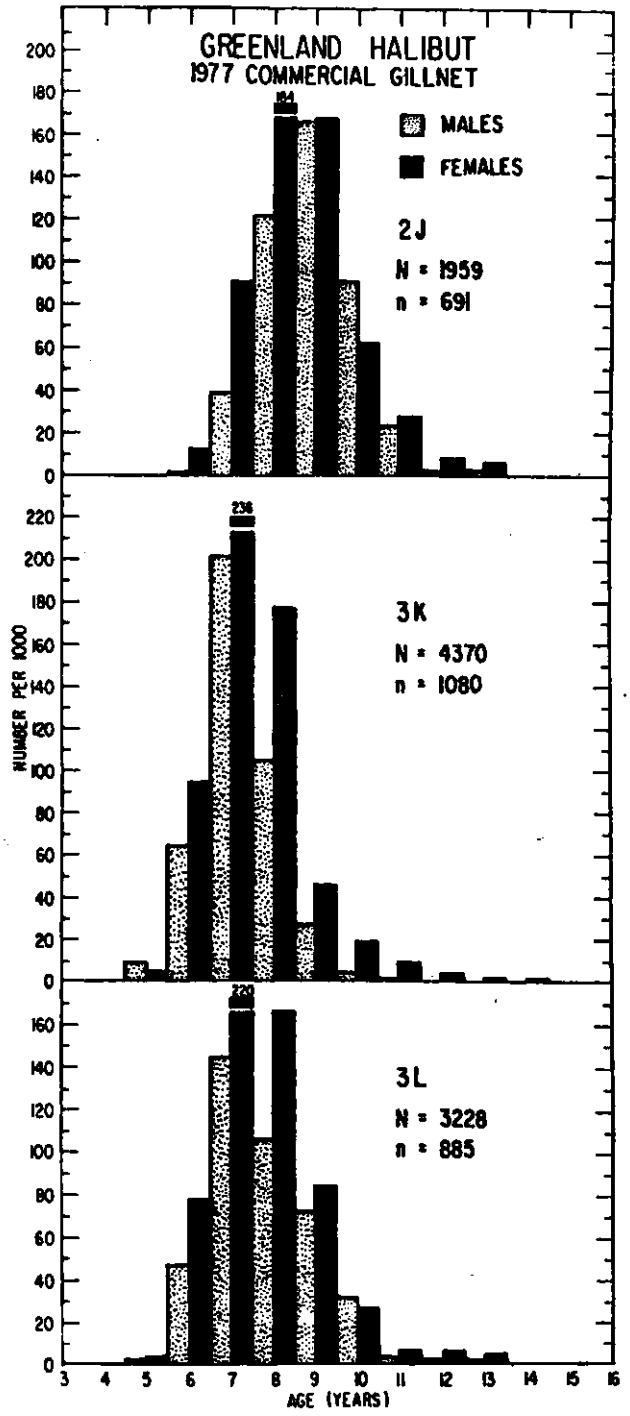

Fig. 3. Age composition of male and female Greenland halibut gillnet catches from ICNAF Divisions 2J, 3K and 3L for 1977.

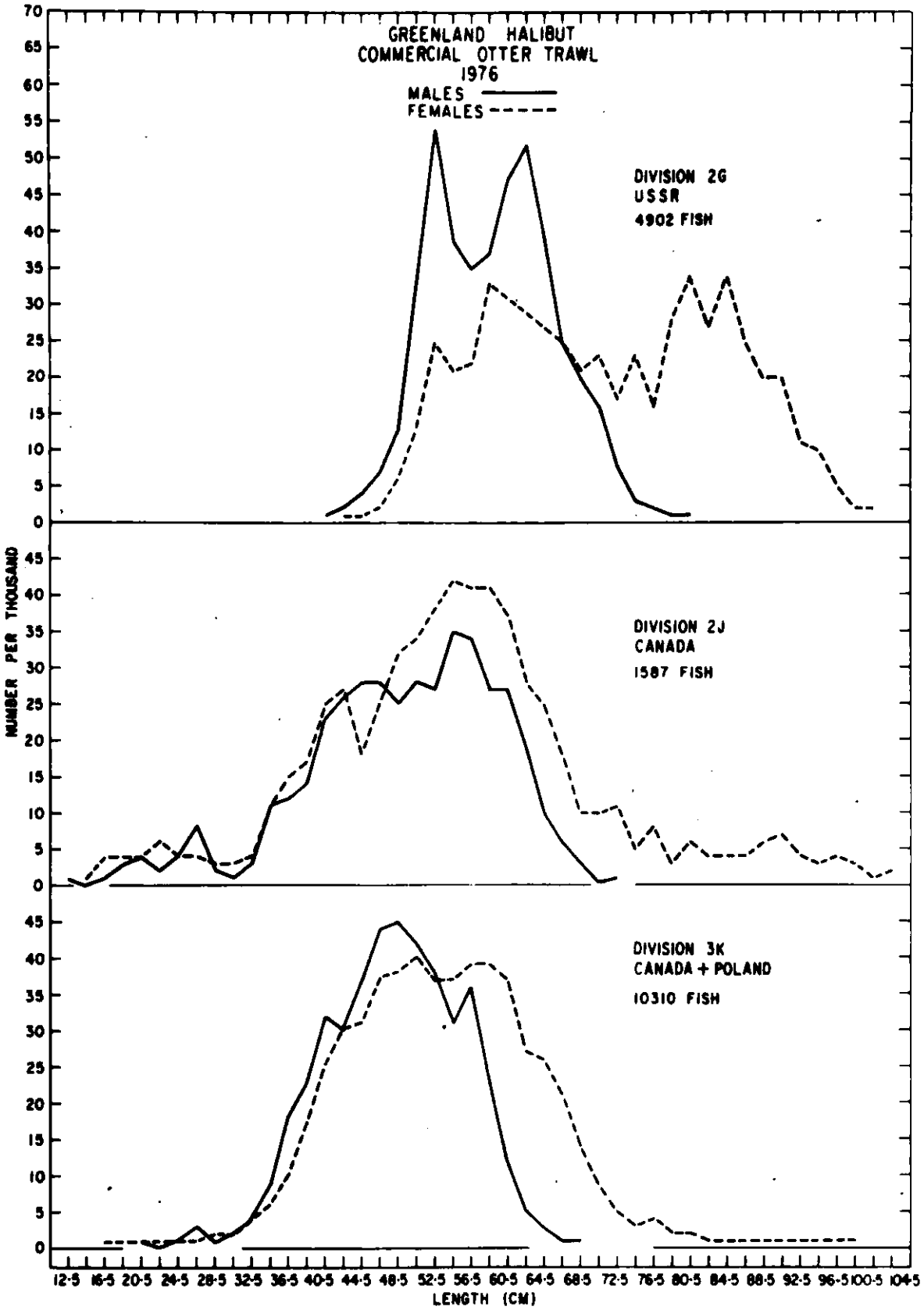

Fig. 4. Length composition of male and female Greenland halibut otter trawl catches from ICNAF Divisions 2G, 2J and 3K for 1976.

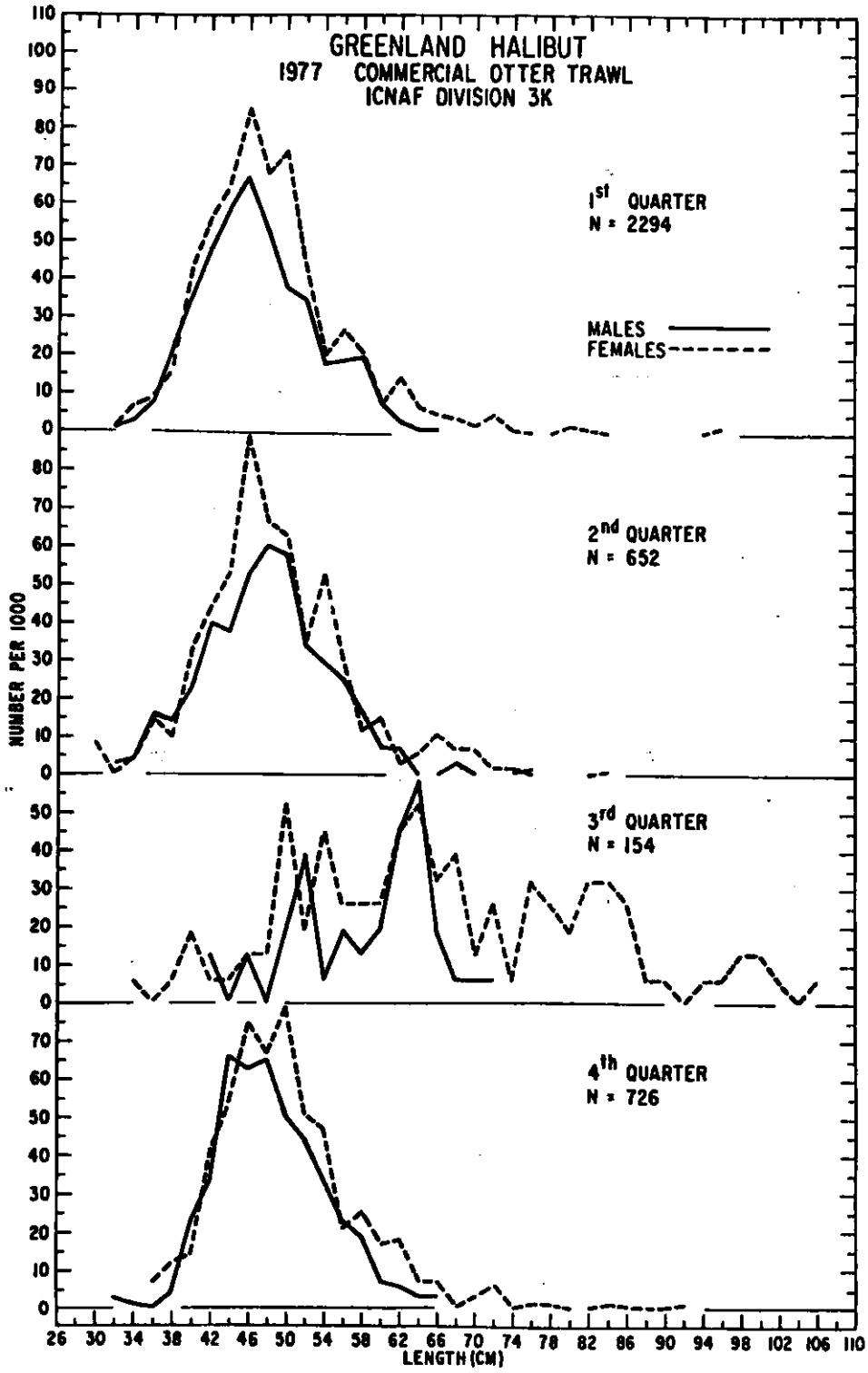

Fig. 5. Length composition of male and female Greenland halibut otter trawl catches from ICNAF Division 3K during each quarter of 1977.

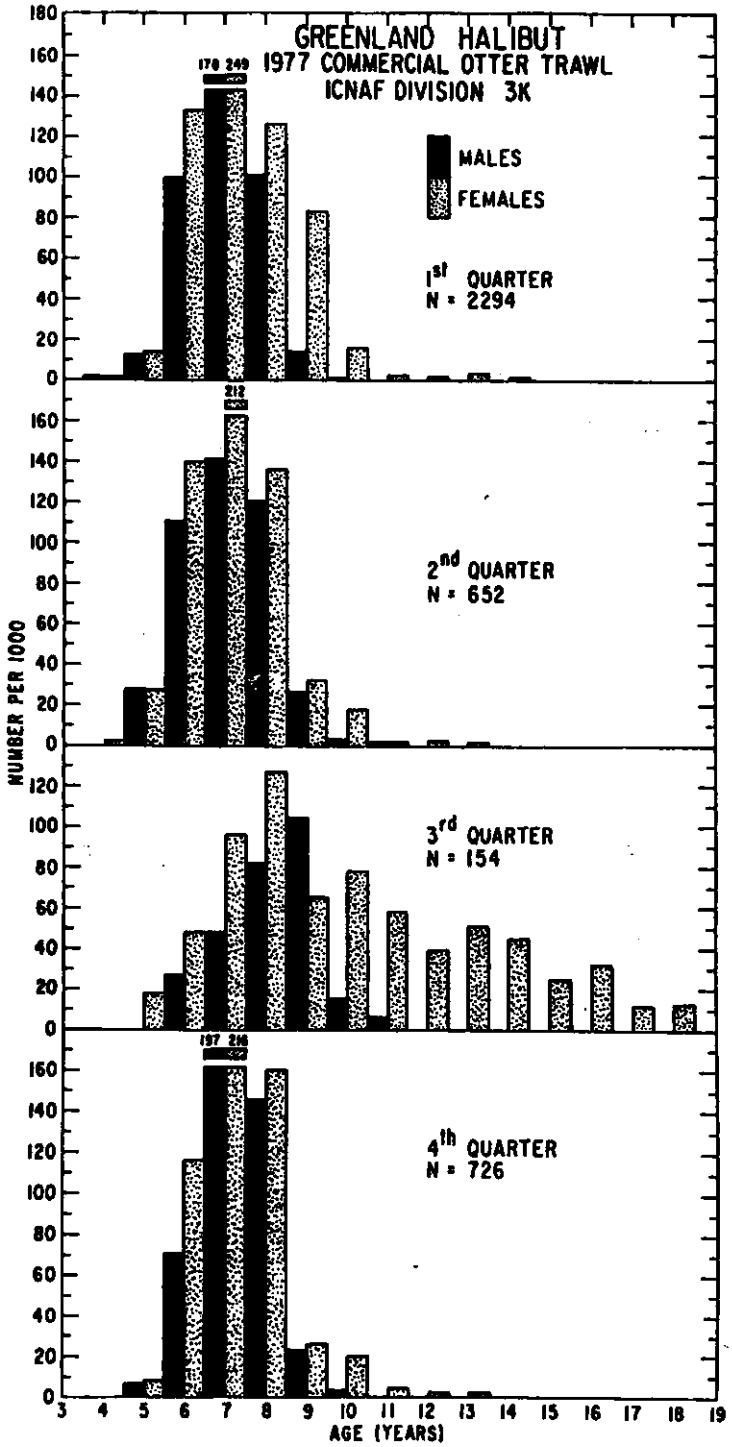

Fig. 6. Age composition of male and female Greenland halibut otter trawl catches from ICNAF Division 3K during each quarter of 1977.

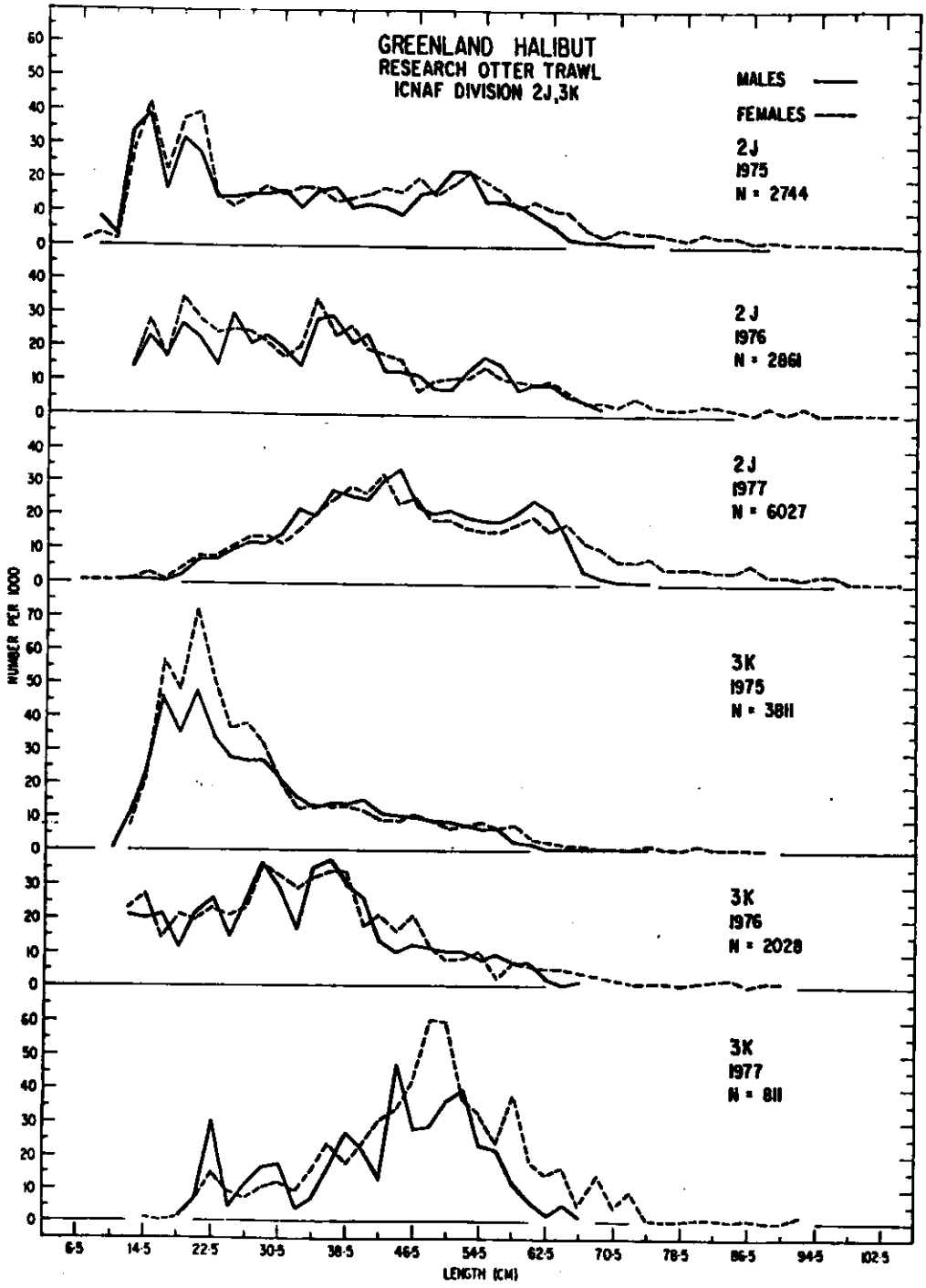

Fig. 7. Length frequency composition from research cruises in ICNAF Divisions 2J and 3K from 1975-77.

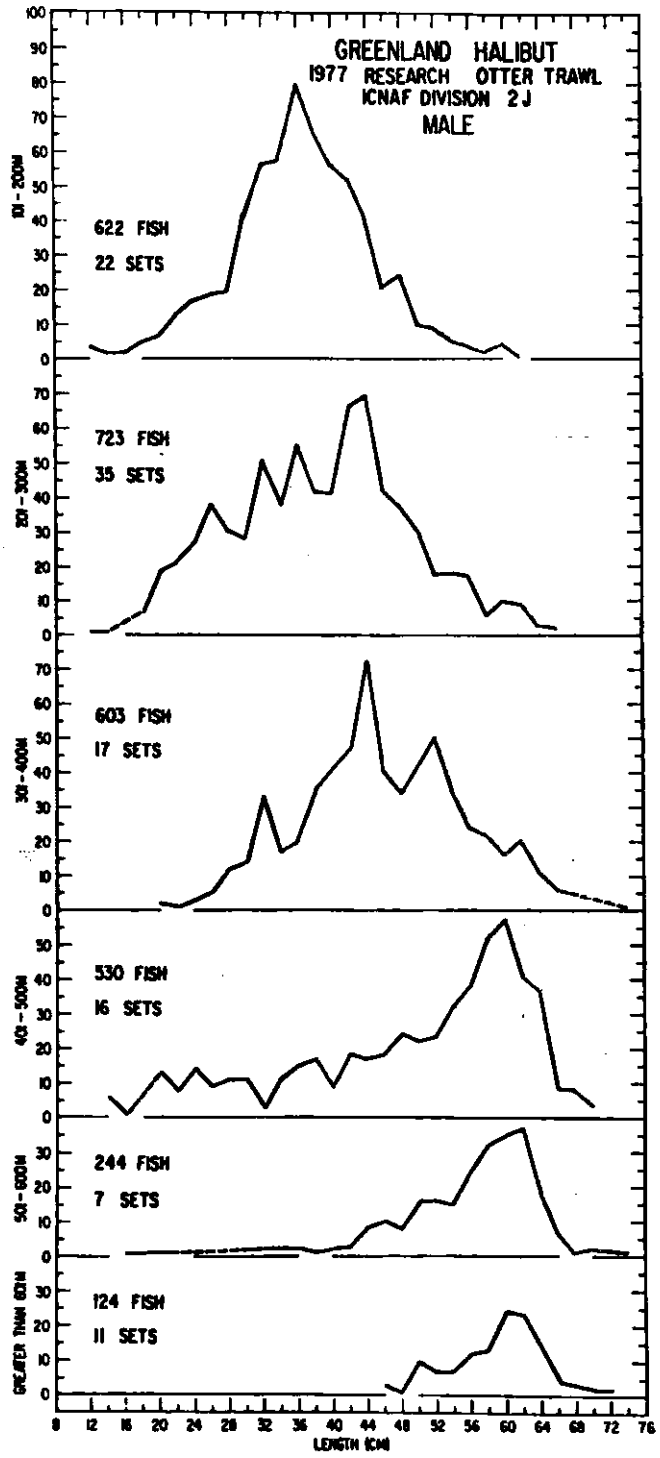

Fig. 8. Length distribution of male Greenland halibut by 100 metre depth categories in ICNAF Division 2J from a research cruise in 1977.

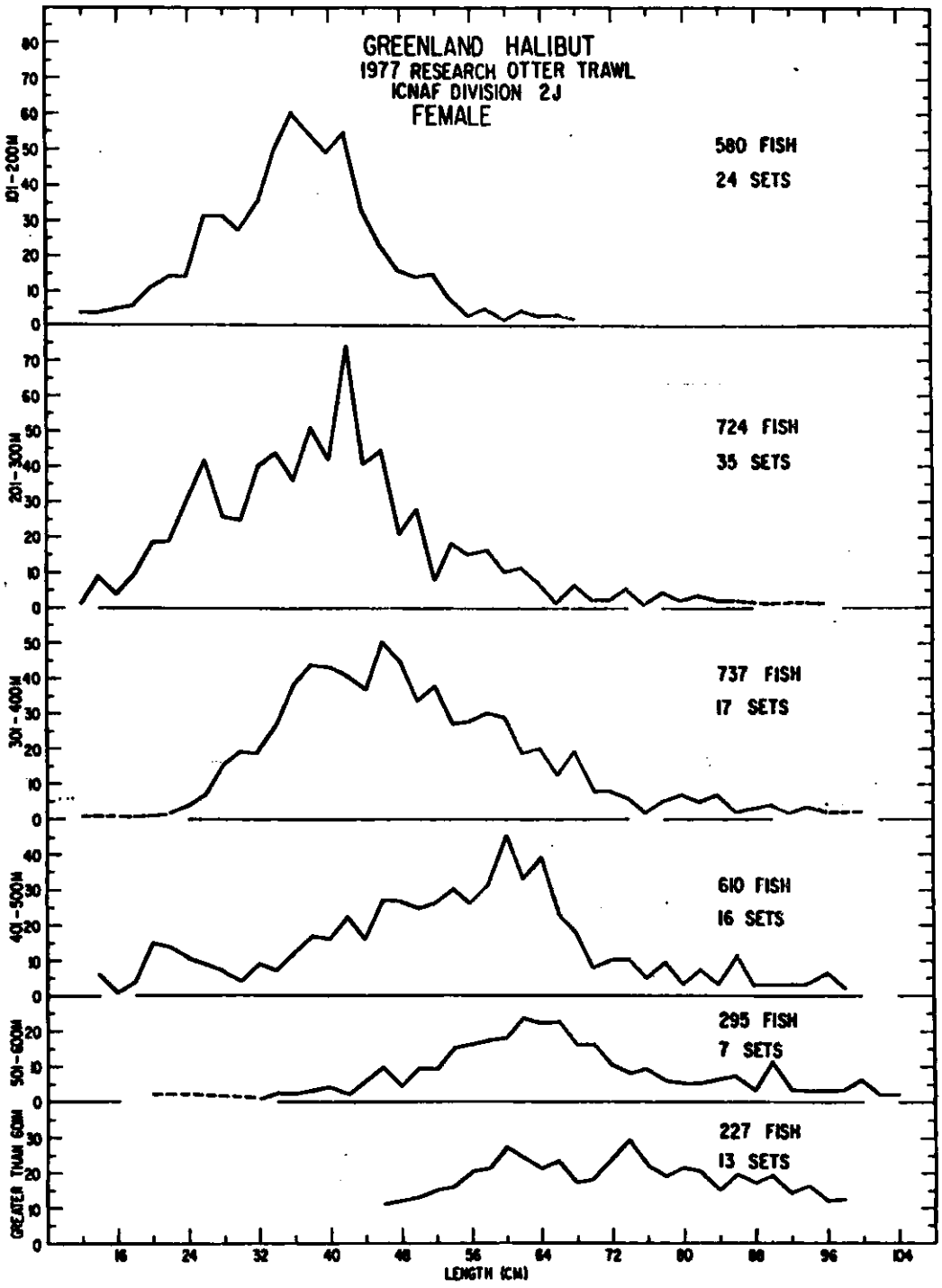

Fig. 9. Length distribution of male Greenland halibut by 100 metre depth categories in ICNAF Division 2J from a research cruise in 1977.

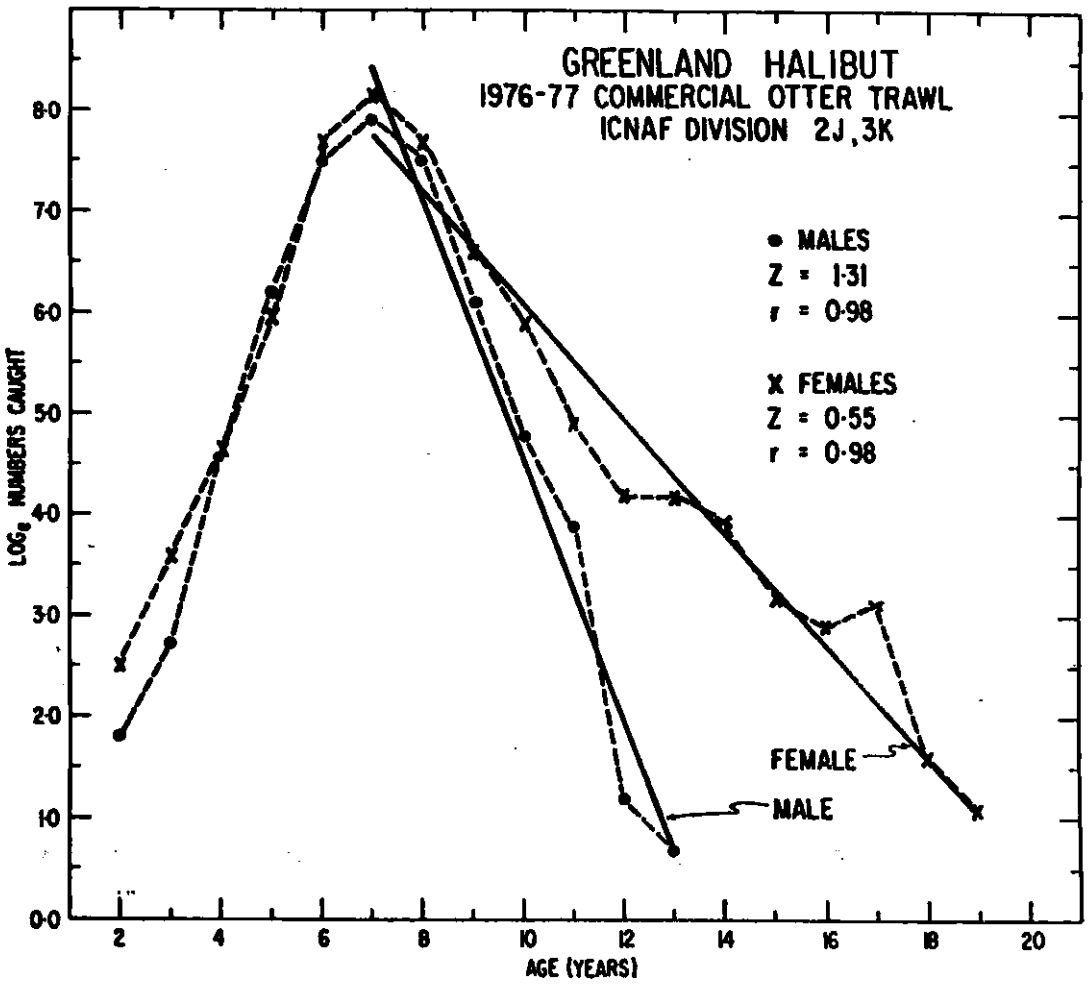

Fig. 10. Catch curves of male and female Greenland halibut from commercial otter trawl catches 1976-77.

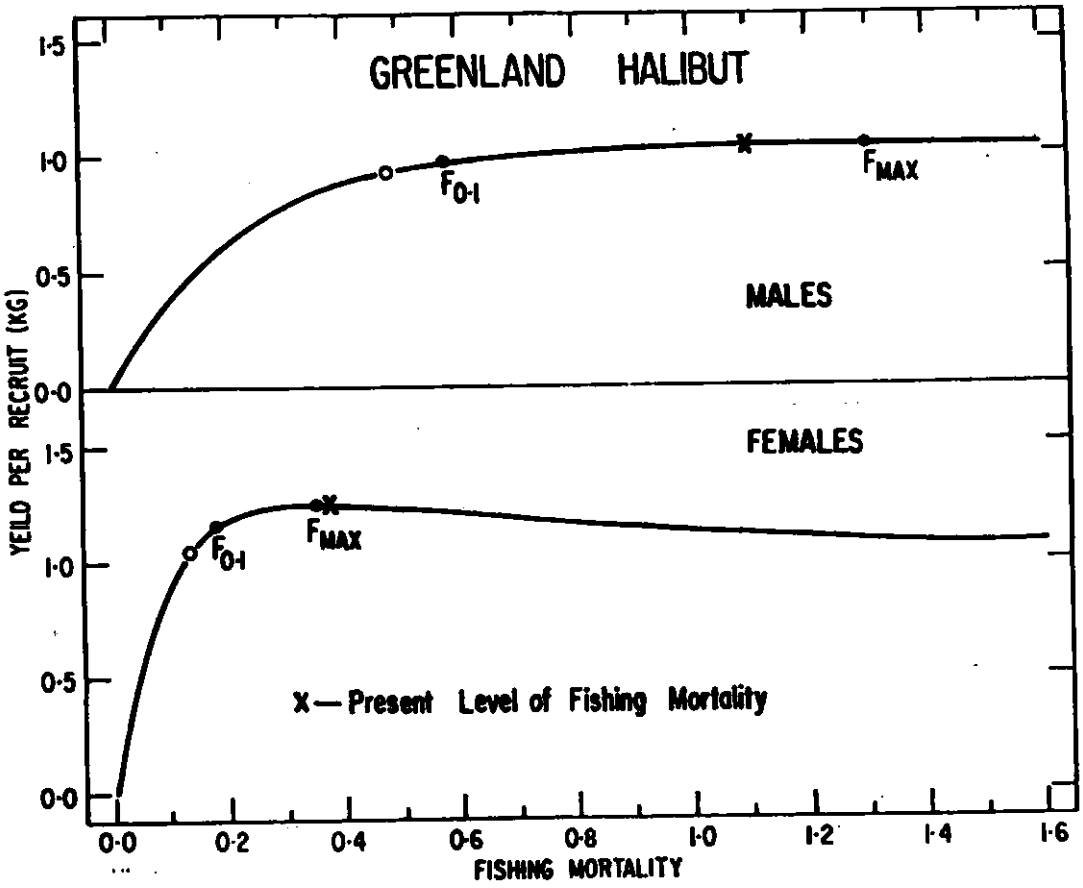

Fig. 11. Yield-per-recruit curves for male and female Greenland halibut from ICNAF Subarea 2 and Divisions 3K and 3L.